GRAPHICAL
MPASS CONVERSION
CHART AND TABLES

COMPILED BY
MAJOR JOHN F. FAIRCHILD
56TH PIONEER INFANTRY, U. S. ARMY

D. VAN NOSTRAND COMPANY
MILITARY AND NAVAL BOOKS
PARK PLACE NEW YORK

Hq., Prov. Depot for Corps and Army Troops,
Camp Wadsworth, 6/13/18.

To the Adjutant General of the Army, Washington, D.C.

1. Recommending approval.

2. This chart appeals to me as an excellent piece of work for which Major Fairchild should receive commendation. Its utility in visualizing and comparing angles according to the several systems is obvious, and I think of sufficient value to warrant approval. Major Fairchild was an engineer before entry into Federal Service and has performed some engineering work for me with marked ability.

GUY CARLETON,
Brigadier General,
Commanding.

.061 (Pub. Div.)
A. G. O., July 9, 1918.

To Major John F. Fairchild, Hq. 1st Corps Troops,
Camp Wadsworth, S. C.

Your letter reference "Publication of Graphical Compass Conversion Chart" is approved.

By order of the Secretary of War,

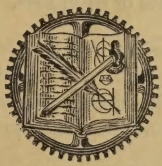
F. W. LEWIS,
Adjutant General.

GRAPHICAL COMPASS CONVERSION CHART AND TABLES

Compiled by

Major John F. Fairchild

56th Pioneer Infantry U. S. Army



D. VAN NOSTRAND COMPANY

MILITARY AND NAVAL BOOKS

25 Park Place NEW YORK

GRAPHICAL COMPASS CONVERSION CHART AND TABLES

COMPILED BY

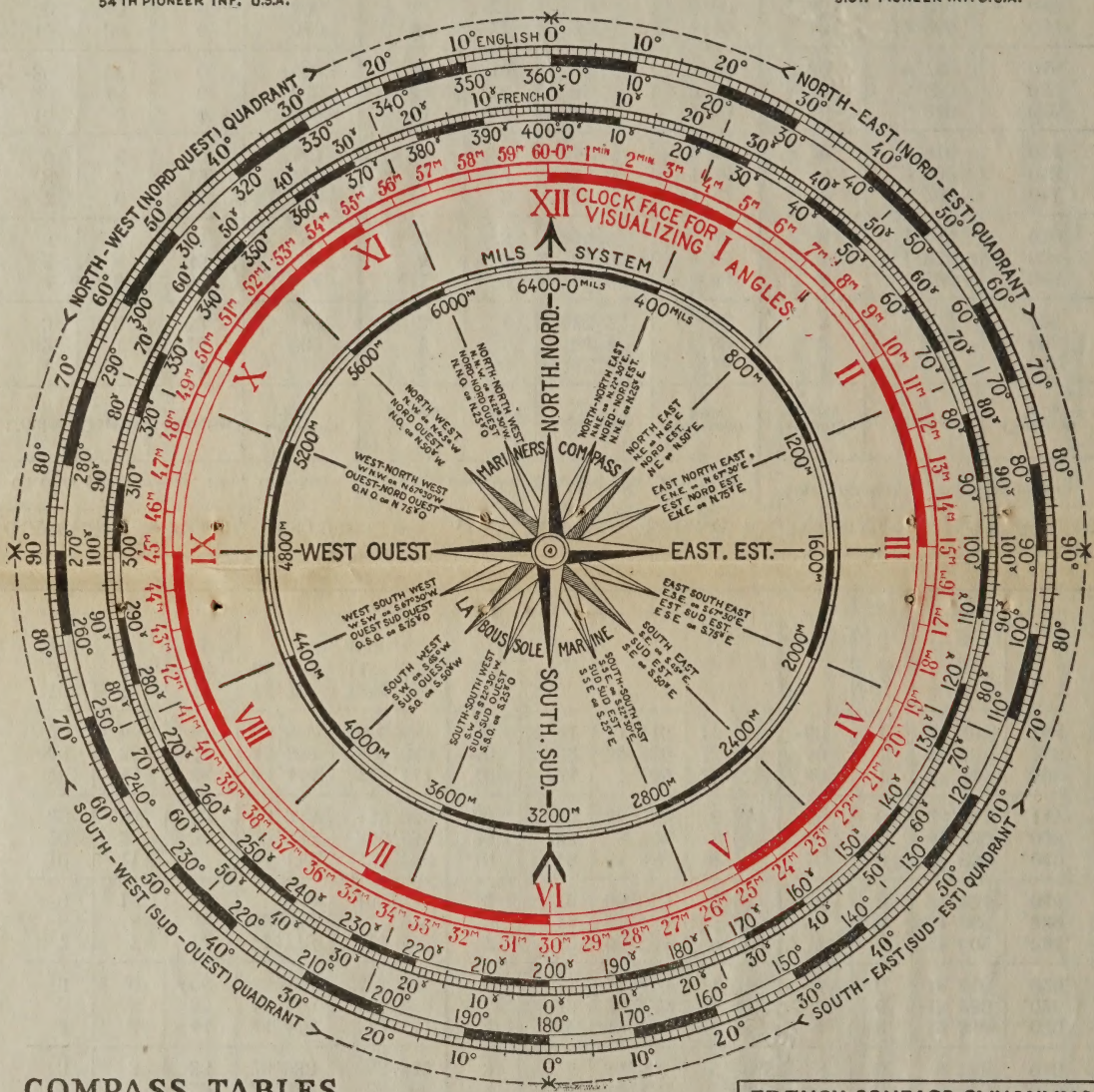
MAJOR JOHN F. FAIRCHILD

56TH. PIONEER INFANTRY U.S. ARMY.

SERG'T CLARENCE R. HAYWARD, 54TH PIONEER INF. U.S.A.

DRAFTING ASSISTANTS.

SERG'T ROBERT C. SCHOPP 51ST. PIONEER INF. U.S.A.



COMPASS TABLES

For the SEXAGESIMAL (English); CENTESIMAL (French) and MILS (Military) SYSTEMS.

Degrees	Minutes	Seconds	Grades	Centigrades	Deci-Miligrades	Mils
1° =	60′ =	3,600″ =	1ᵍ +	11ᶜ +	11.111ᶜᶜ =	17.778 M.
	1′ =	60″ =		1ᶜ +	85.185ᶜᶜ =	.296 M.
		1″ =			3.086ᶜᶜ =	.005 M.
	54′ =	3240.″ =	1ᵍ =	100ᶜ =	10,000.ᶜᶜ =	16. M.
		324″ =		1ᶜ =	100ᶜᶜ =	.16 M.
		0.324″ =			1ᶜᶜ =	.0016M.
	3′ +	22.5″ =		6ᶜ +	25ᶜᶜ =	1 Mil

Quadrant = 90 Degrees = 100 Grades = 1,600 Mils
Circle = 360 " = 400 " = 6,400 "

FRENCH COMPASS SYNONYMS

FROM VARIOUS AUTHORITIES

Grade; Grad; Degree; G; ᵍ; ʳ.
Centigrade; Centesimal; Minute ᶜ; ᶜ.
Deci-Miligrade; Seconde; Seconde-Centesimal; ᶜᶜ; ᶜᶜ.

VARIOUS MILS SYSTEMS

"True" Tan = 1/1,000 = 6,283.18 to Circle. = 3′26.265″ = 6′36.62ᶜᶜ
"Common" 1600 System = 6,400 to Circle. = 3′22.5″ = 6′25ᶜᶜ
"Rimailho" System, = 6,000 to Circle. = 3′36″ = 6′66.667ᶜᶜ
German Heavy Artillery = 5,760 to Circle. = 3′45″ = 6′94.444ᶜᶜ

GRAPHICAL COMPASS CONVERSION CHART AND TABLES

The graphical chart is designed, primarily, to afford a ready method of comparison between the American (English) and French method of denoting circle and magnetic compass angles and also of comparison with the mils system used in military practice, accompanied by a clock face for assistance in visualizing angles.

It consists of a Mariner's Compass (la marine boussoule), showing the twelve principal compass points, and the mariner's designation of each point with their abbreviation and quadrant direction in both English and French.

Outside of the Mariner's Compass is given a circle divided for the 6400 divisions of the "common" mils system.

Outside of the mils circle is given a clock face for assistance in visualizing angles. The inside divisions and numbers give the hours and those outside give the minutes. A clock hand in passing from 12 o'clock to 1 o'clock passes through an angle of 30 degrees or 33⅓ grades; from 12 to 2 o'clock of 60 degrees or 66⅔ grades; from 12 to 3 o'clock of 90 degrees or 100 grades and so on around the clock face. Each minute on the clock represents an angle of 6 degrees or 6⅔ grades.

Next to the clock face is given a circle divided according to the French Centesimal or "grade" system. The inside figures state the divisions from 0–400 grades around he circle, clockwise, while the outside figures state the divisions by quadrants from the north and south.

The outside circle is divided according to the Sexagesimal system (English) used in America. The inside figures state the divisions from 0–360 degrees around the circle, clockwise, while the outside figures state the divisions by quadrants from the north and south.

Outside of the circles are given the English and French designations of the four quadrants.

The "Compass Tables" on the face of the chart give on the left of the upper space the English system complete in itself and in the center of the second space the French system complete in itself. Opposite each of these is given the value of the subdivision in terms of the other system and also of the "common" mils system. Below is given the value of a mil in each of the other systems and the division of the quadrant and circle by each of the three systems.

The research necessary to obtain accurate information in the preparation of the chart developed the fact that various French and English technical and military dictionaries and works use different terms in referring to the French circle divisions. A table of all such synonyms found is given on the face of the chart. In the chart and tables those terms are used which seemed the most harmonious and euphonious and which afforded no chance for confusion with those used in the other tables.

The research also developed four "mils" systems in use. The original or "true" mils system was devised for military use, so as to give an angle based on a direct relation between the tangent of the angle and the radius of the circle (the range of the artillery) this relation being

$$\frac{1}{1000} = \frac{\text{tangent}}{\text{radius of circle.}}$$

This scheme divided the circle into 6283.18 parts, each part being called a "mil." This odd division was found cumbersome and about 1880 Colonel Rimailho, a French officer, devised the system ("Rimailho") of using an even 6000 parts to the circle instead of 6283.18, making an error of 283.18 parts from the "true" system.

This amount of error was found unsatisfactory and the "common" mils system of 6400 divisions to the circle was adopted, this number being the nearest even hundred to the "true" system, making an error of only 116.82 points instead of 283.18 as in the "Rimailho" system.

A table of these four mil systems is given on the face of the chart.

The chart can be used as a protractor by cutting out a small triangle at the 180 degrees—0 degrees or 90 degrees—90 degrees points and half of the small circle in the center of the mariner's compass and using a ruler to carry the angle over the chart paper.

The general Conversion Tables accompanying the chart will enable the use in computation of any table of logarithms or natural functions by converting the given angle into the angular designation on which is based the available table of logarithms or natural functions.

CONVERSION TABLE SEXAGESIMAL SYSTEM TO CENTESIMAL AND COMMON MILS SYSTEMS

Degrees to Grades, etc., and Mils

Degrees	Grades	Centigrades	Decimilligrades	Common Mils
1	1	11	11.111	17.778
2	2	22	22.222	35.556
3	3	33	33.333	53.333
4	4	44	44.444	71.111
5	5	55	55.556	88.889
6	6	66	66.667	106.607
7	7	77	77.778	124.445
8	8	88	88.889	142.222
9	10	0	0	160.
10	11	11	11.111	177.778
20	22	22	22.222	355.556
30	33	33	33.333	533.333
40	44	44	44.444	711.111
50	55	55	55.556	888.889
60	66	66	66.667	1066.667
70	77	77	77.778	1244.445
80	88	88	88.889	1422.222
90	100	0	0	1600.

Minutes to Centigrades, etc., and Mils

Minutes	Centigrades	Decimilligrades	Common Mils
1	1	85.185	.296
2	3	70.370	.593
3	5	55.555	.889
4	7	40.740	1.185
5	9	25.925	1.482
6	11	11.110	1.778
7	12	96.295	2.074
8	14	81.480	2.370
9	16	66.665	2.667
10	18	51.850	2.963
20	37	3.700	5.926
30	55	55.550	8.889
40	74	7.400	11.852
50	92	59.250	14.815
60	1.11	11.110	17.778

Seconds to Decimilligrade Mils

Seconds	Centigrades	Decimilligrades	Mils
1	0	3.086	.005
2	0	6.172	.010
3	0	9.258	.015
4	0	12.344	.020
5	0	15.430	.025
6	0	18.516	.029
7	0	21.602	.034
8	0	24.688	.039
9	0	27.774	.044
10	0	30.860	.049
20	0	61.720	.098
30	0	92.58	.147
40	1	23.44	.196
50	1	54.30	.245
60	1	85.16	.294

Conversion Table Centigrade System to Sexagesimal and Common Mils Systems

Grades to Degrees, etc., and Mils

Grades	Degrees	Minutes	Common Mils
1	0	54	16
2	1	48	32
3	2	42	48
4	3	36	64
5	4	30	80
6	5	24	96
7	6	18	112
8	7	12	128
9	8	06	144
10	9	0	160
20	18	0	320
30	27	0	480
40	36	0	640
50	45	0	800
60	54	0	960
70	63	0	1120
80	72	0	1280
90	81	0	1440
100	90	0	1600

Centigrades to Minutes, etc., and Mils

Centigrades	Minutes	Seconds	Common Mils
1	0	32.4	.16
2	1	04.8	.32
3	1	37.2	.48
4	2	09.6	.64
5	2	42.0	.80
6	3	14.4	.96
7	3	46.8	1.12
8	4	19.2	1.28
9	4	51.6	1.44
10	5	24.0	1.60
20	10	48	3.20
30	16	12	4.80
40	21	36	6.40
50	27	0	8.00
60	32	24	9.60
70	37	48	11.20
80	43	12	12.80
90	48	36	14.40
100	54	00	16.00

Decimilligrades to Seconds and Mils

Decimilligrades	Seconds	Common Mils
1	.324	.002
2	.648	.003
3	.972	.005
4	1.296	.006
5	1.620	.008
6	1.944	010
7	2.268	.011
8	2.592	.013
9	2.916	.014
10	3.240	.016
20	6.480	.032
30	9.720	.048
40	12.960	.064
50	16.200	.080
60	19.440	.096
70	22.680	.112
80	25.920	.128
90	29.160	144
100	32.400	.160

CONVERSION TABLE COMMON MILS SYSTEM TO SEXAGESIMAL AND CENTESIMAL SYSTEMS

MILS TO DEGREES, ETC., AND GRADES, ETC.

Common Mils	Degrees	Minutes	Seconds	Grades	Centigrades	Decimiligrades
1	0	3	22.5	0	6	25
2	0	6	45	0	12	50
3	0	10	07.5	0	18	75
4	0	13	30	0	25	0
5	0	16	52.5	0	31	25
6	0	20	15	0	37	50
7	0	23	37.5	0	43	75
8	0	27	0	0	50	0
9	0	30	22.5	0	56	25
10	0	33	45	0	62	50
20	1	07	30	1	25	0
30	1	41	15	1	87	50
40	2	15	0	2	50	0
50	2	48	45	3	12	50
60	3	22	30	3	75	0
70	3	56	15	4	37	50
80	4	30	0	5	0	0
90	5	03	45	5	62	50
100	5	37	30	6	25	0
200	11	15	0	12	50	0
300	16	52	30	18	75	0
400	22	30	0	25	0	0
500	28	07	30	31	25	0
600	33	45	0	37	50	0
700	39	22	30	43	75	0
800	45	0	0	50	0	0
900	50	37	30	56	25	0
1000	56	15	0	62	50	0
1100	61	52	30	68	75	0
1200	67	30	0	75	0	0
1300	73	07	30	81	25	0
1400	78	45	0	87	50	0
1500	84	22	30	93	75	0
1600	90	0	0	100	0	0

To reduce other mils systems to "Common" mils, multiply "True" mils by 1.018592; multiply "Rimailho" mils by 1.066667; multiply German H. A. mils by 1.111111.

MILITARY AND NAVAL BOOKS

MILITARY SKETCHING AND MAP READING
By Major John B. Barnes
Ill. 4½x5¾ 110 Pages $0.75

THE WHYS AND WHEREFORES OF NAVIGATION
By Gershom Bradford
Executive Officer Schoolship *Newport*
Ill. 5¼x7½ 200 Pages $2.00

DESIGN OF MARINE ENGINES AND AUXILIARIES
By Prof. E. M. Bragg, S.B.
110 ill. 4 folding plates 6x9 192 pages $3.00

MARINE GAS ENGINES
Their Construction and Management
By Carl H. Clark, S.B.
Second Edition, Revised and Enlarged
144 Pages 5¼x7¾ Ill. $2.00

THE NAVAL CONSTRUCTOR
By George Simpson
Fourth Enlarged Edition
950 Pages 370 Ill. 4½x7 $5.00

MILITARY OBSERVATION BALLOONS
(Captive and Free)
By Emil J. Widmer
38 Ill. 2 plates 5¼x7½ 200 pages $3.00

THE ATTACK IN TRENCH WARFARE
By Capt. Andre Laffargue
90 Pages 5 folding plates 3⅝x5⅛ Ill. $0.50

THE SUBMARINE TORPEDO BOAT
Characteristics and Modern Development
By Allen Hoar
Ill. 4 folding pages 5¾x8 228 pages $2.00

MODERN SEAMANSHIP
By Admiral Austin M. Knight, U. S. N.
Seventh Edition, Revised and Enlarged
159 plates 5¼x7½ 700 pages $3.00

BAYONET TRAINING MANUAL
Used by the British Forces
72 Pages Fully Ill. 3⅝x5⅛ $0.30

TACTICS AND TECHNIQUE OF RIVER CROSSINGS
By Colonel Mertens
Translated from the German by
Major Walter Krueger, U. S. A.
105 Ill. 4 folding plates 6x9
300 pages $2.50

A HANDBOOK OF PRACTICAL SHIP BUILDING
By. J. D. MacBride
Superintendent in Hull Construction
Hog Island Shipyards
240 Pages 100 Ill. 5¼x7¾ $2.00

THE MEN ON DECK
Master, Mates and Crew: Their Duties and Responsibilities
Manual for the American Merchant Service
By Felix Riesenberg, C.E.
Commanding Schoolship *Newport*
Ill. 5x7 250 pages $3.00

NAVIGATION AND NAUTICAL ASTRONOMY
By Prof. J. H. C. Coffin, Late of U. S. Naval Academy
New Edition Revised and Brought Up-to-date
By Elmer C. Collins
Nautical Expert Hydrographic Office
Ill. 5¼x7½ 250 pages $3.00

HANDBOOK FOR THE CARE AND OPERATION OF NAVAL MACHINERY
By Comm. H. C. Dinger, U. S. N.
Third Edition, Revised and Enlarged
437 pages 5¼x7¾ Ill. $3.00

Operation and Tactical Use of the LEWIS AUTOMATIC MACHINE RIFLE
150 pages 3 folding plates 3⅝x5⅛ Ill. $0.60

MILITARY AND NAVAL RECOGNITION BOOK
A handbook on the organization, insignia of rank, and customs of the service of the World's Important Armies and Navies
By Lieut. Comm. J. W. Bunkley, U. S. N.
280 pages 5x7 Ill. $1.00

D. VAN NOSTRAND COMPANY, NEW YORK